WHAT IS CLAIMED IS:

1. In an apparatus having a combustion engine and an emissions system including a catalytic converter and a metal oxide catalyst disposed downstream of the catalytic converter, a method of controlling a chemical transformation of hydrogen sulfide in an emissions stream to a less-noxious sulfur-containing compound, comprising:

reacting the hydrogen sulfide with the metal oxide catalyst to form a metal sulfide;

monitoring a saturation of the metal oxide catalyst with the metal sulfide;

when a predetermined saturation of metal sulfide on the metal oxide is reached, changing an air/fuel ratio supplied to the combustion engine to increase a concentration of an oxidant flowing to the metal oxide catalyst; and

reacting the oxidant with the metal sulfide.

2. The method of claim 1, wherein monitoring a saturation of the metal oxide catalyst with the metal sulfide includes monitoring a concentration of hydrogen sulfide in the emissions stream and determining an amount of hydrogen sulfide that binds to the metal oxide catalyst via an efficiency factor.

3. The method of claim 2, wherein monitoring a concentration of hydrogen sulfide in the emissions stream includes multiplying an estimated amount of sulfur on a NO_x trap within the catalytic converter by an efficiency factor that depends on a NO_x trap temperature and an air/fuel mixture consumed to produce the emissions stream.

4. The method of claim 3, wherein monitoring a concentration of hydrogen sulfide in the emissions stream includes monitoring a concentration of hydrogen sulfide in the emissions stream under a rich air/fuel ratio.

5. The method of claim 1, wherein changing the air/fuel ratio supplied to the engine includes making the air/fuel ratio leaner.

6. The method of claim 1, wherein reacting the oxidant with the metal sulfide includes reacting the oxidant with the metal sulfide to form sulfur dioxide.

7. The method of claim 6, further comprising lowering a temperature of the metal oxide catalyst when the predetermined saturation of metal sulfide is reached.

8. The method of claim 6, further comprising monitoring a quantity of sulfur dioxide formed, and when a predetermined quantity of sulfur dioxide has been formed, raising the temperature of the metal oxide catalyst and changing the air/fuel ratio supplied to the engine.

9. The method of claim 8, wherein monitoring a quantity of sulfur dioxide formed includes monitoring a concentration of sulfur dioxide in the emissions stream, and determining an amount of sulfur dioxide that reacts with the nickel sulfide via an efficiency factor.

10. The method of claim 8, wherein changing the air/fuel ratio supplied to the engine includes making the air/fuel ratio more rich.

11. The method of claim 1, wherein reacting the oxidant with the nickel sulfide includes reacting the oxidant with the nickel sulfide to form nickel sulfate.

12. The method of claim 11, further comprising monitoring a quantity of nickel sulfate formed, and when a predetermined quantity of nickel sulfate has been formed, then raising the temperature of the metal oxide catalyst and changing the air/fuel ratio supplied to the engine to convert the nickel sulfate to nickel oxide and sulfur dioxide.

13. The method of claim 12, wherein monitoring a quantity of nickel sulfate formed includes monitoring a concentration of sulfur dioxide in the emissions stream, and determining an amount of sulfur dioxide that reacts with the nickel sulfide via an efficiency factor.

14. The method of claim 13, wherein monitoring a concentration of sulfur dioxide in the emissions stream includes multiplying an estimated amount of sulfur on a NO_x trap within the catalytic converter by an efficiency factor that depends on a NO_x trap temperature and an air/fuel mixture.

15. The method of claim 12, wherein changing the air/fuel ratio supplied to the engine includes making the air/fuel ratio more lean.

16. In an apparatus having a combustion engine, an emissions treatment system for chemically transforming hydrogen sulfide in an emission stream to a less-noxious sulfur-containing compound, the emissions treatment system comprising:

a conduit configured to transport emissions away from the combustion engine;

a catalytic converter disposed along the conduit, the catalytic converter including a NO_x trap;

a hydrogen sulfide converter disposed along the conduit downstream of the catalytic converter;

an air/fuel detector disposed along the conduit;

a temperature sensor disposed along the conduit; and

a controller in electrical communication with the temperature sensor and the air/fuel detector, wherein the controller includes memory, a processor, and code stored in memory and executable by the processor to monitor a saturation of the hydrogen sulfide converter with hydrogen sulfide, and to change an air/fuel mixture provided to the combustion engine when a predetermined saturation of the hydrogen sulfide converter with hydrogen sulfide is reached.

17. The apparatus of claim 16, wherein the code is executable by the processor to monitor a saturation of the hydrogen sulfide converter by monitoring an amount of sulfur on the NO_x trap and calculating an estimated amount of hydrogen sulfide leaving the NO_x trap as a function of temperature.

18. The apparatus of claim 17, wherein the code is executable to calculate the estimated amount of hydrogen sulfide leaving the NO_x trap by multiplying the amount of sulfur on the NO_x trap by an efficiency factor dependent upon a temperature and an air/fuel mixture.

19. The apparatus of claim 18, wherein the code is executable to calculate the saturation of the hydrogen sulfide converter with hydrogen sulfide by multiplying the amount of hydrogen sulfide leaving the NO_x trap by an efficiency factor that relates to the efficiency of hydrogen sulfide adsorption on the hydrogen sulfide converter.

20. The apparatus of claim 17, wherein the code is executable to determine the estimated amount of hydrogen sulfide leaving the NO_x trap as a function of temperature from a look-up table.

21. The emissions treatment system of claim 17, wherein the instructions are executable to determine the concentration of hydrogen sulfide in the emissions stream while a rich air/fuel mixture is being consumed.

22. The emissions treatment system of claim 16, wherein the hydrogen sulfide converter includes a nickel oxide surface, and wherein the hydrogen sulfide entering the hydrogen sulfide converter adsorbs to the nickel oxide surface as nickel sulfide.

23. The emissions treatment system of claim 21, wherein the code is executable to change the air/fuel mixture to a more lean air/fuel mixture when a predetermined saturation of the hydrogen sulfide converter with hydrogen sulfide is reached to oxidize the nickel sulfide to at least one of nickel sulfate and sulfur dioxide.

24. The emissions treatment system of claim 23, wherein the code is executable to monitor a saturation of the nickel oxide surface with nickel sulfate, and to change the air/fuel mixture to a more rich mixture when a predetermined saturation of the nickel oxide surface with nickel sulfate is reached.

25. The emissions treatment system of claim 24, wherein the code is executable to monitor the saturation of the nickel oxide surface with nickel sulfate by monitoring an estimated concentration of sulfur dioxide leaving the NO_x trap and entering the hydrogen sulfide converter.

26. The emissions treatment system of claim 25, wherein the code is executable to monitor the estimated concentration of sulfur dioxide by multiplying an estimated amount of sulfur in the NO_x trap by a factor related to an efficiency of sulfur dioxide formation as a function of a NO_x trap temperature and the air/fuel mixture.

27. The emissions treatment system of claim 24, wherein the code is executable to monitor an amount of nickel oxide regenerated after the air/fuel mixture is changed to a more rich mixture.

28. The emissions treatment system of claim 27, wherein the code is executable to monitor the amount of nickel oxide regenerated by monitoring an amount of hydrogen flowing into the hydrogen sulfide detector, and multiplying the amount of hydrogen by an efficiency factor related to an absorption of hydrogen on nickel sulfate.

29. The emissions treatment of claim 28, wherein the code is executable to monitor an amount of hydrogen flowing into the hydrogen sulfide converter by estimating a hydrogen concentration in the emissions stream from the air/fuel mixture and from an equilibrium water-gas-shift constant evaluated at a temperature of the NO_x trap.